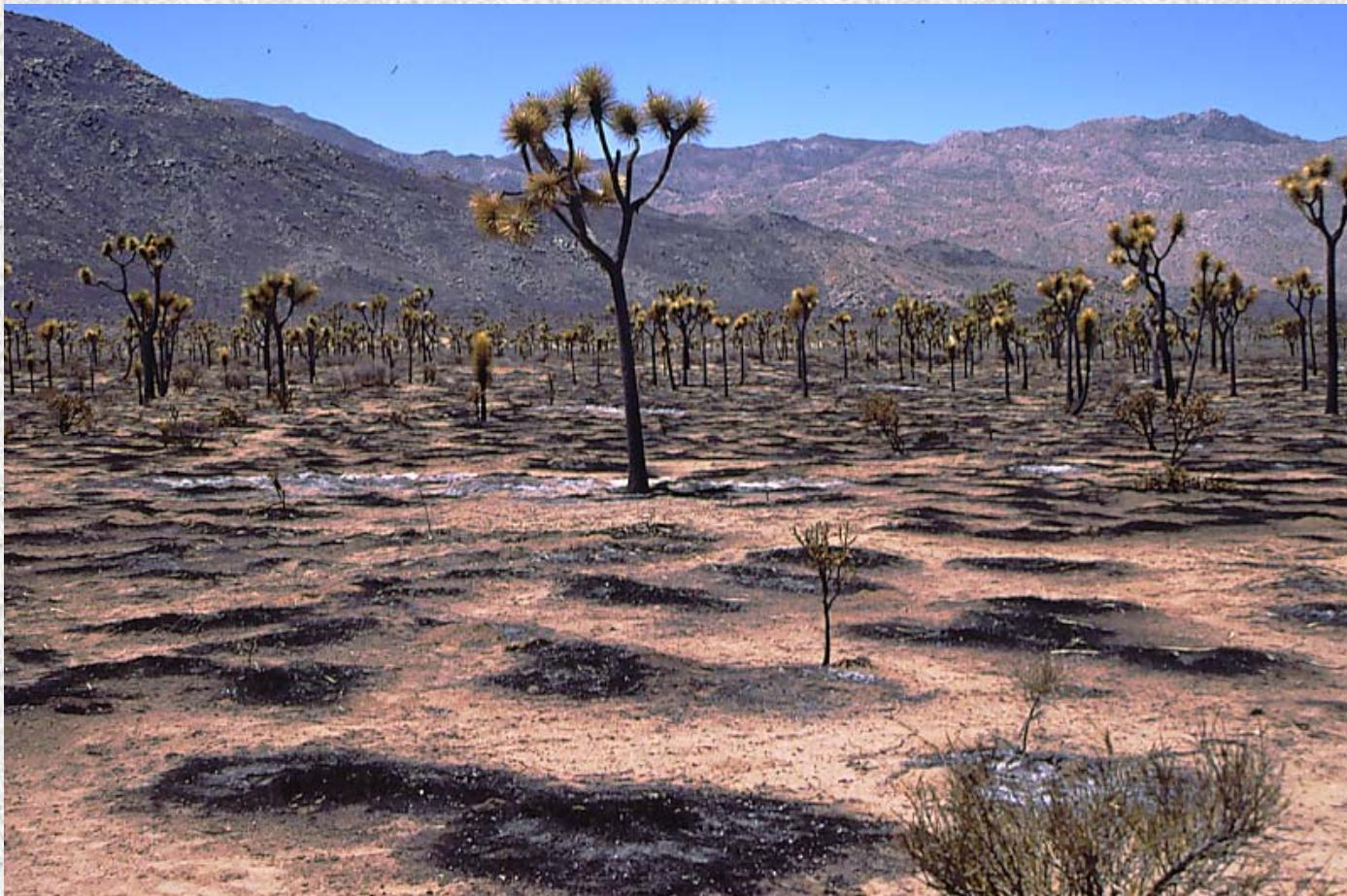
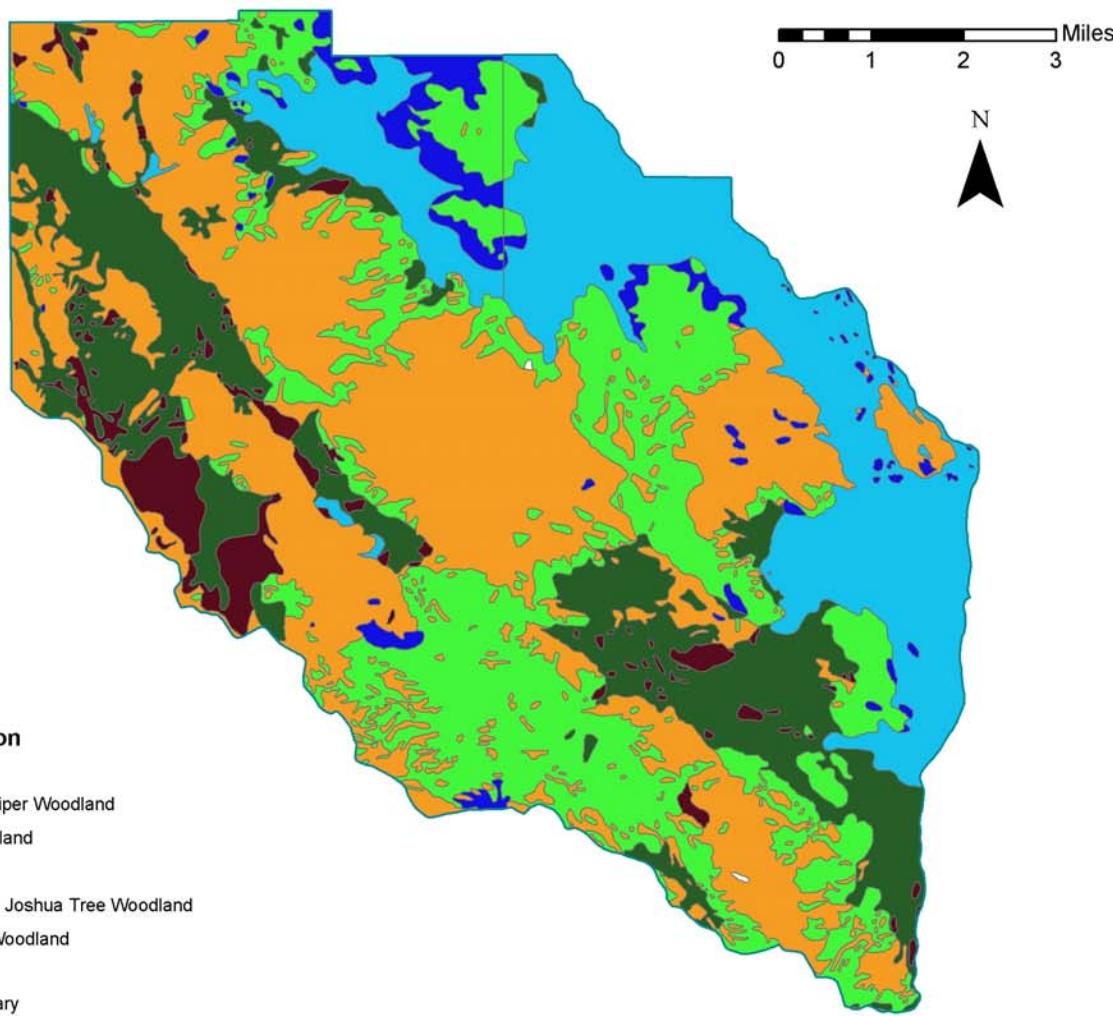


Fire history of Joshua tree National Park: The importance of invasive annual grasses

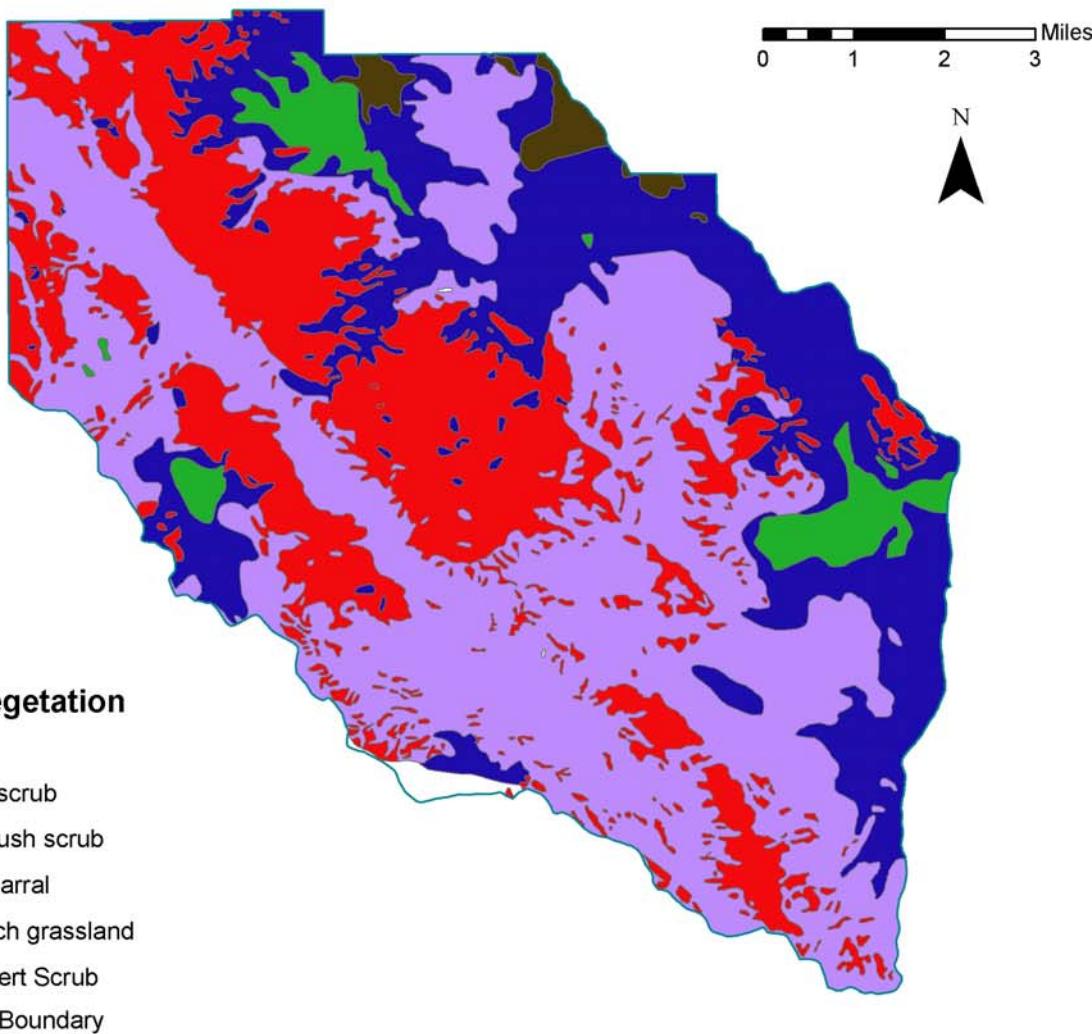
Richard A. Minnich, University of California Riverside



Overstory Vegetation



Understory Vegetation



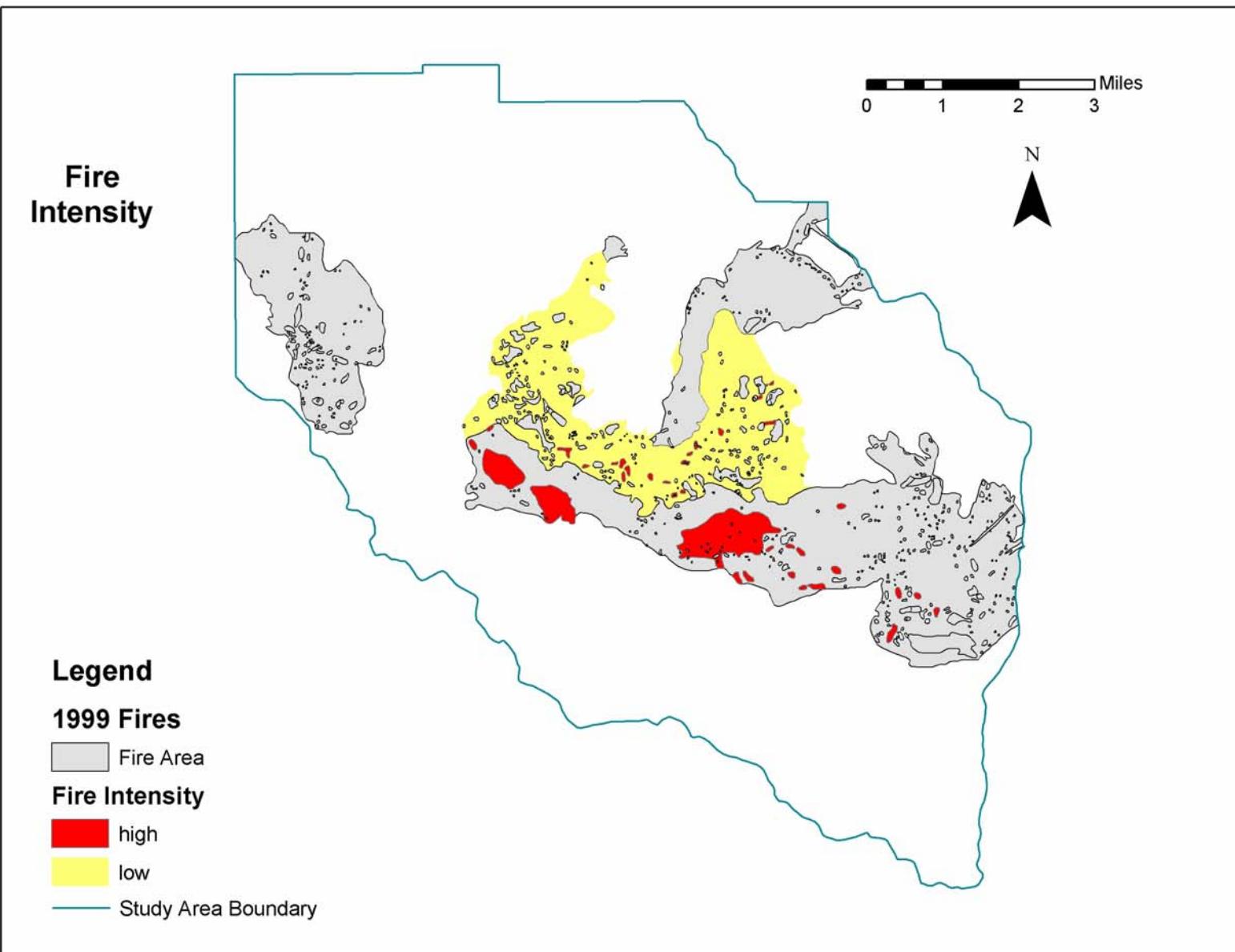


1938



1987





Fires 1942 to 1998

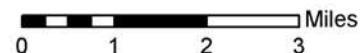
Legend

Fires 1942 to 1998

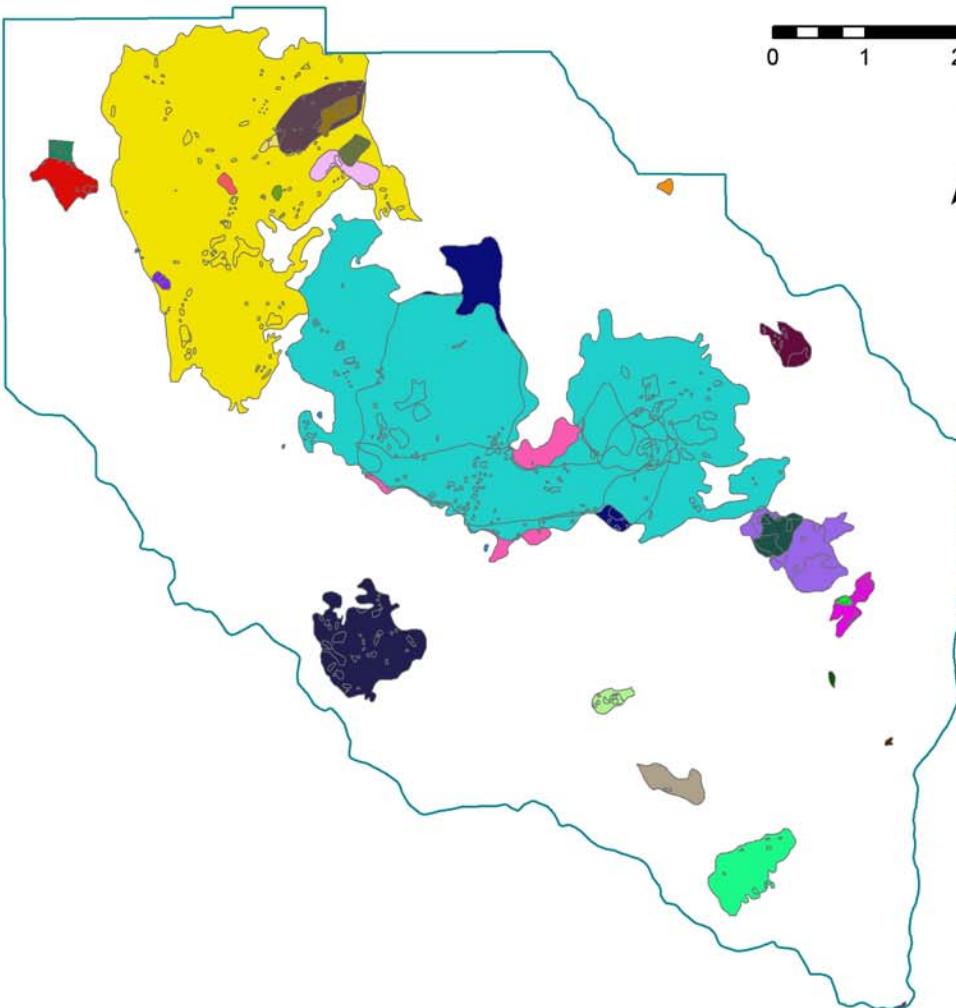
BURNDATE1

- [Dark Green] 1965 July 15
- [Dark Olive Green] 1967 July 14
- [Teal] 1968
- [Olive Green] 1968 July 23
- [Brown] 1970's
- [Cyan] 1978
- [Purple] 1979
- [Light Green] 1979 Aug 18
- [Dark Blue] 1979 June 4
- [Dark Purple] 1980
- [Dark Brown] 1980 Aug 11
- [Light Brown] 1982 or 1984
- [Green] 1984 (1)
- [Very Dark Blue] 1984 (2)
- [Orange] 1984 April 4
- [Light Green] 1984 May 30
- [Red] 1985 (1)
- [Dark Green] 1985 (2)
- [Pink] 1985 (3)
- [Light Pink] 1987
- [Maroon] 1987 May 9
- [Magenta] 1987 Sept 2
- [Dark Teal] 1989 (1)
- [Yellow] 1989 (2)
- [Dark Purple] 1990's ?
- [Red] 1993
- [Yellow] 1995
- [Blue] none

Study Area Boundary

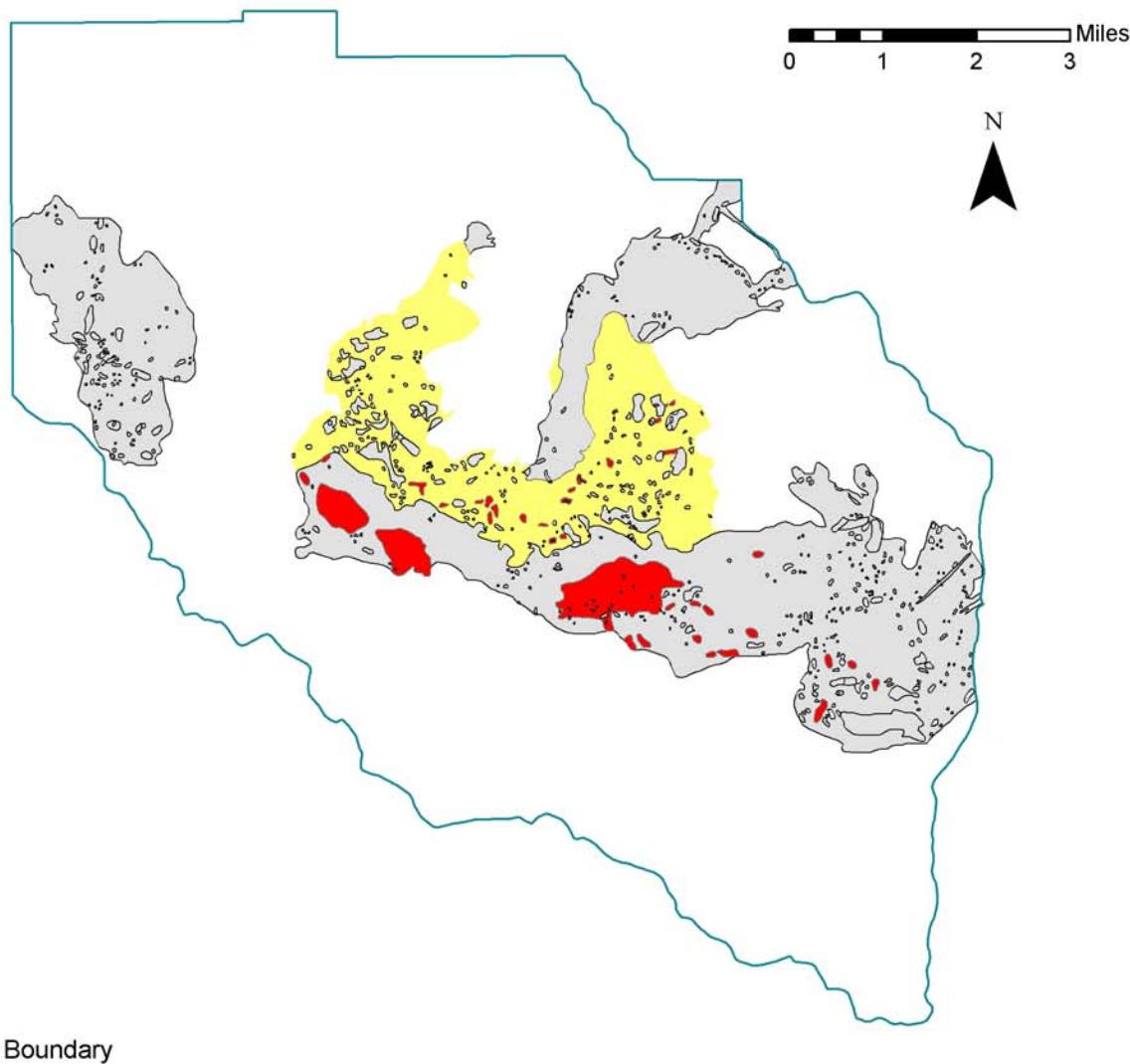


N

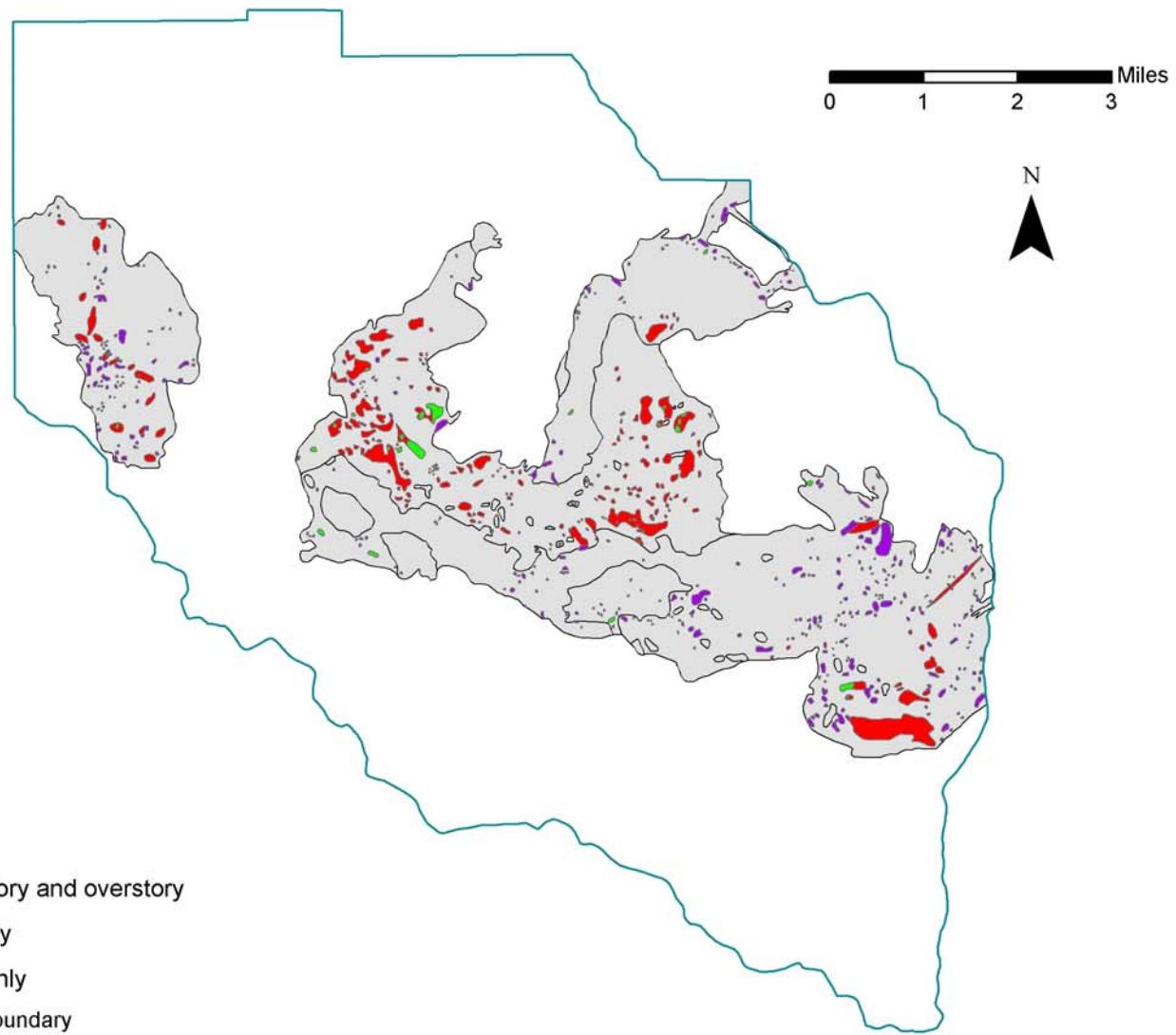




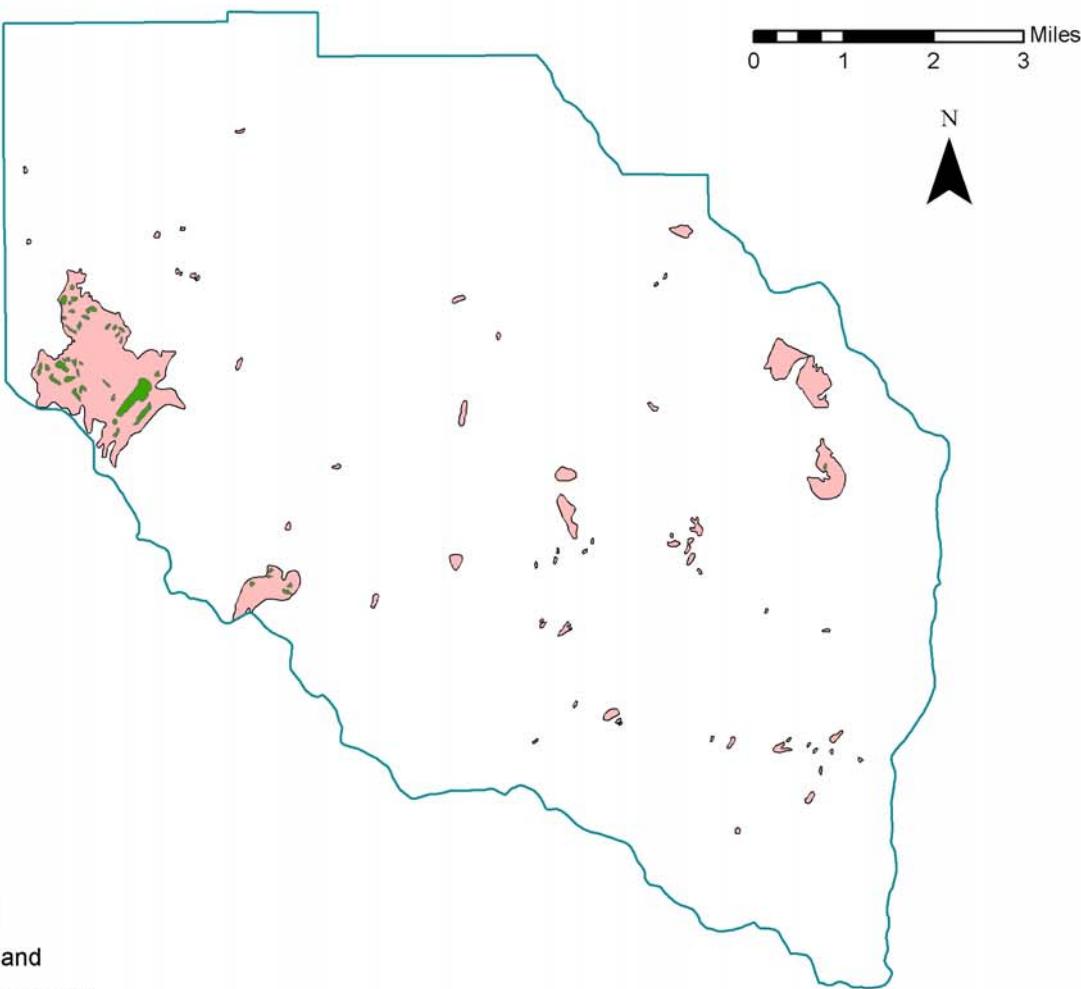
Fire Intensity



Fire Island Survival

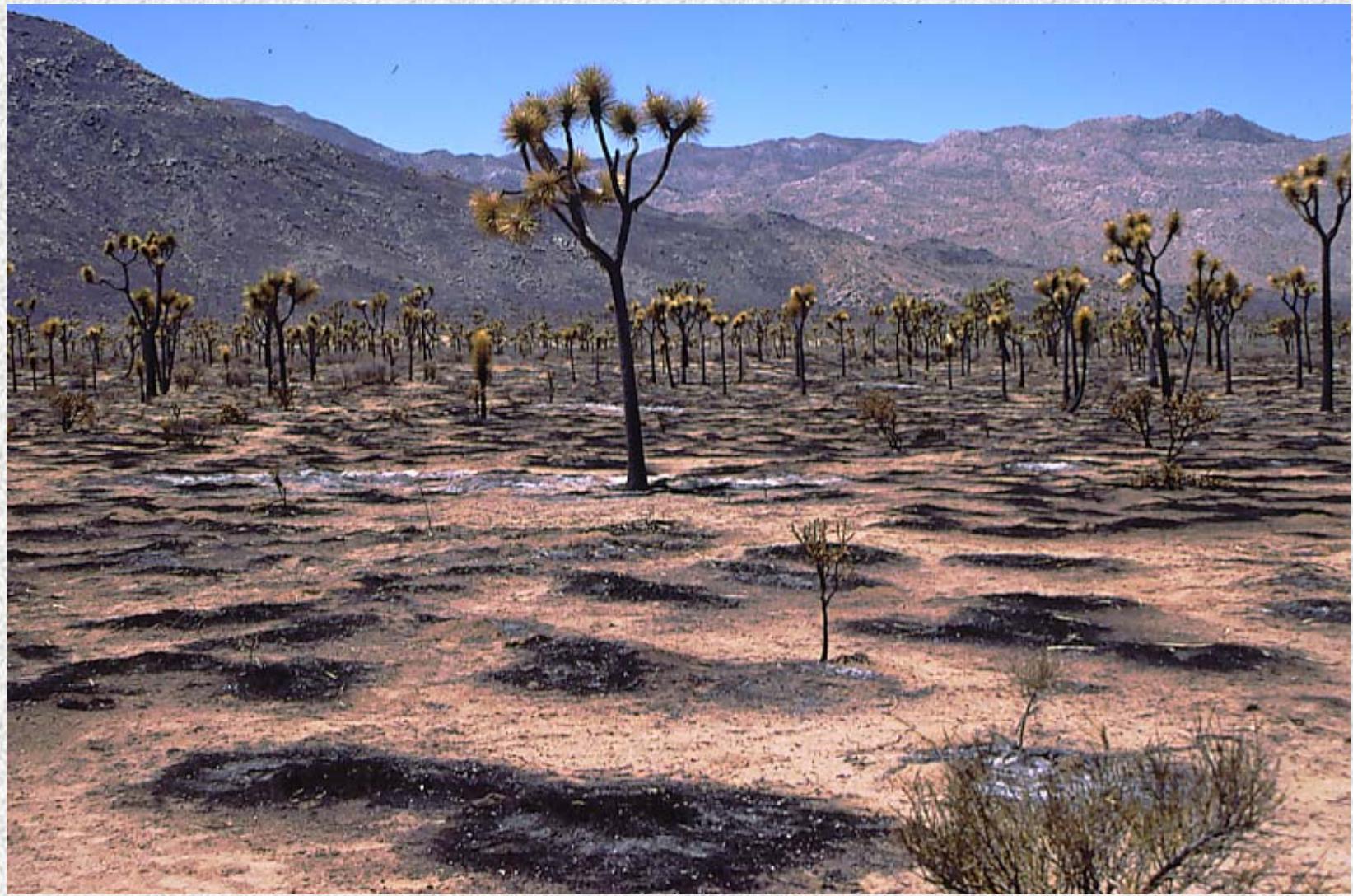


**Fires
Before
1942**



Legend

- fairly recent
- unburned island
- Study Area Boundary



1987



Juniper Flat

1999



Post-fire succession in Joshua Tree Woodland



1-year



9 years



22 years



46 years

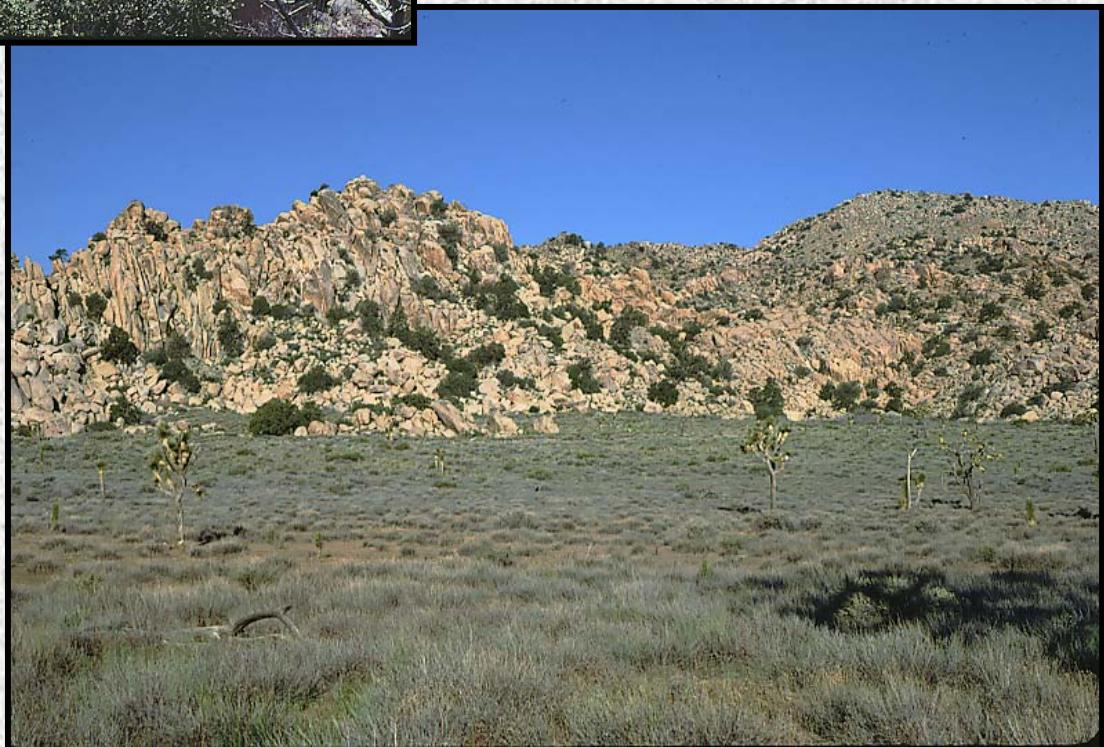


Post-fire succession in California juniper blackbrush scrub

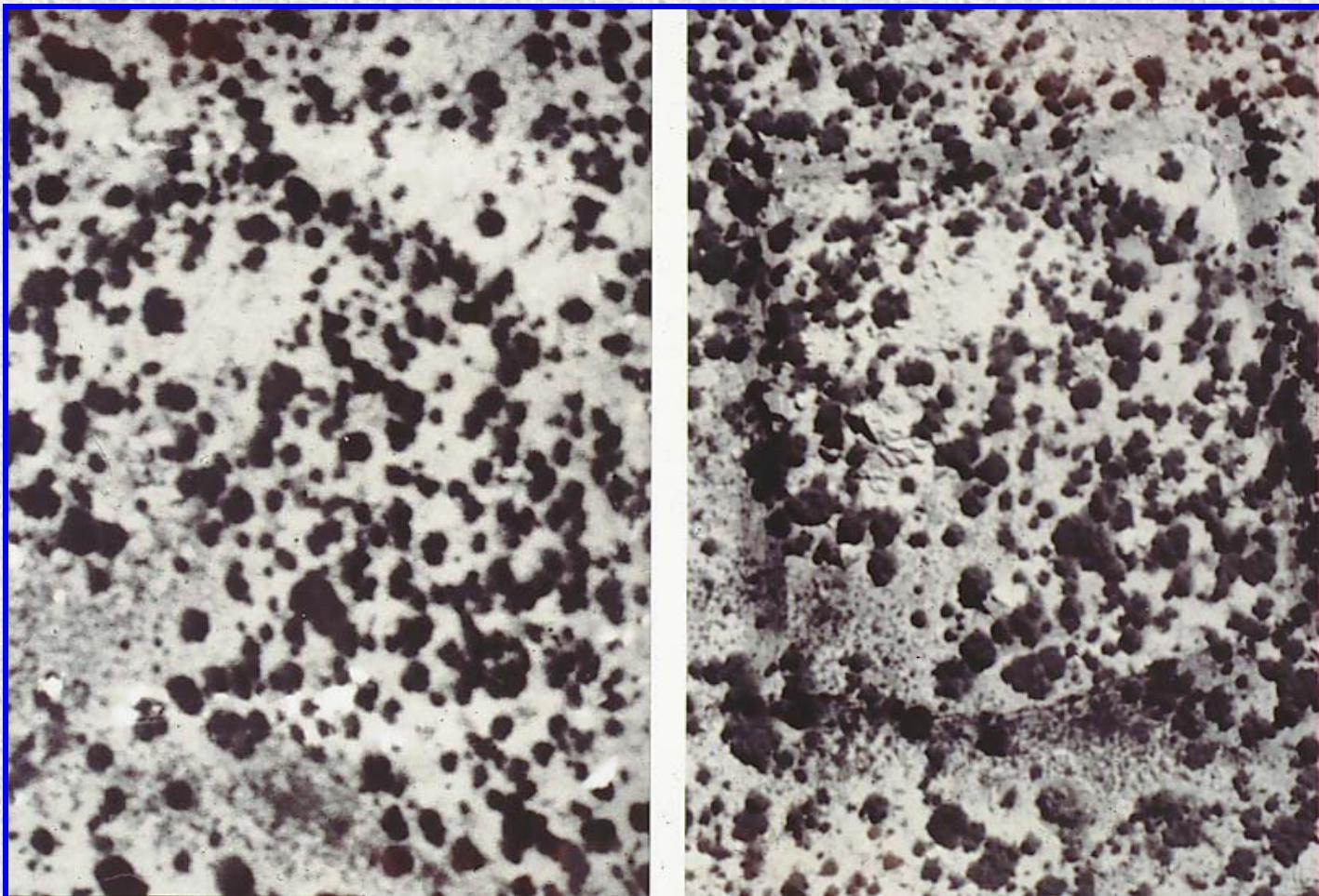




Post-fire succession in pinyon-juniper woodland



Long-term population dynamics



1938

1987

Table 2. Stand density and cover of temperate desert woodlands of Joshua Tree National Park¹.

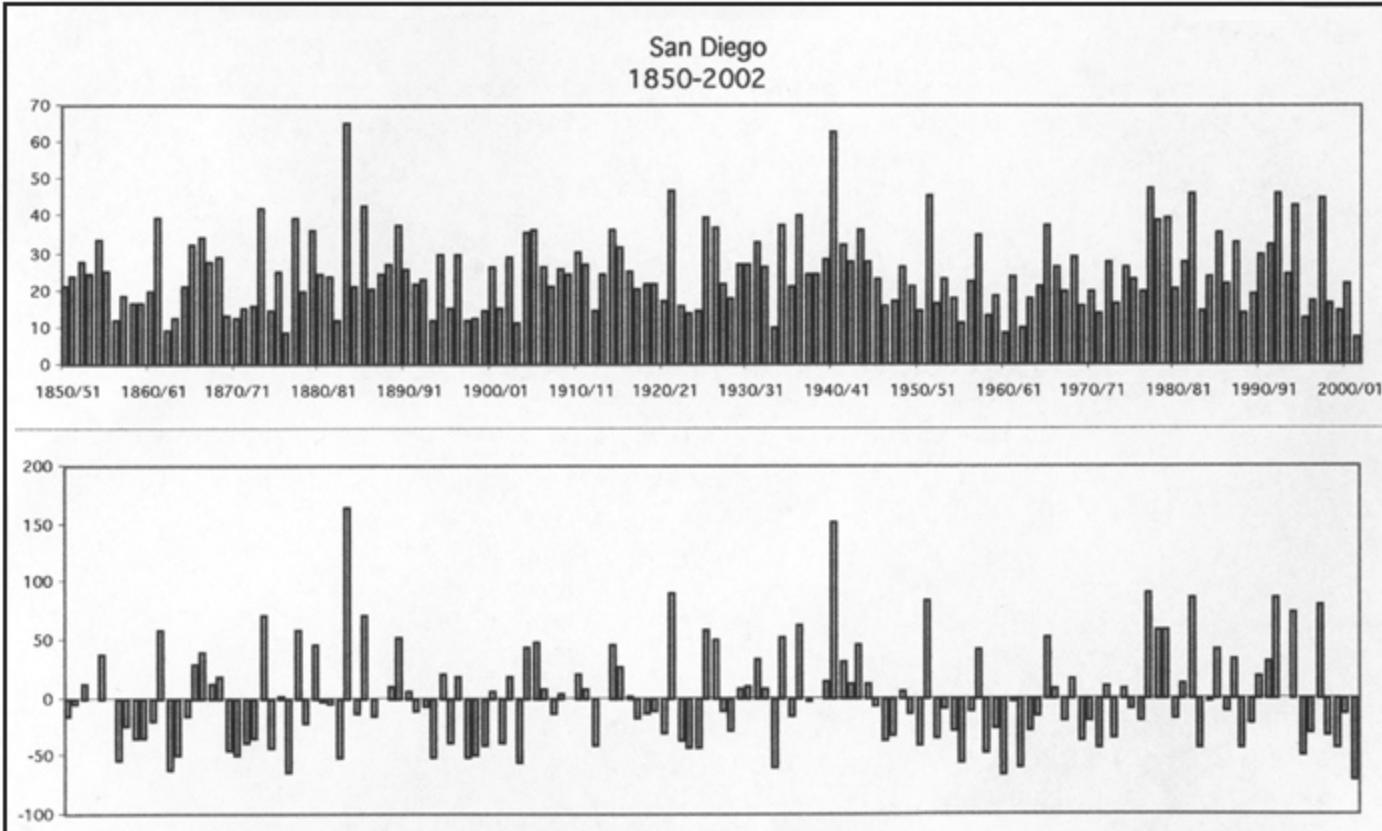
Vegetation Type (1998)/ Stand property	Pinyon-Juniper Woodland	Pinyon-Juniper-Joshua tree Woodland	Juniper Joshua Tree Woodland	Joshua Tree Woodland	Juniper Woodland	Desert Chaparral
Density (ha-1)						
Conifer	98.2	65.9	24.9	0.3	57.5	2.3
Desert Chaparral	24.9	4.3	0.2	0	1.6	60.9
Joshua Tree	1.2	13.6	27.5	39.0	1.5	0.1
Conif+chap, 1998	123.1	70.2	25.0	0.3	59.1	62.9
Conif+chap, 1954	119.3	63.0	21.5	1.8	59.7	124.3
1954-1998, conif+chap						
Mortality	1.8	0.9	0.7	0.1	2.1	61.5
Recruitment	4.5	8.1	4.3	0	1.6	0
Cover (%)						
Conifer	16.9	13.5	4.3	0	5.9	0.7
Desert chaparral	3.2	1.1	0.1	0	0.2	5.6
Joshua Tree	0	1.9	2.1	1.5	0	0
Conifer+chap, 1998	20.1	14.6	4.4	0	6.0	6.3
Conifer+chap, 1954	20.0	13.5	4.1	0	6.1	25.4

1. The vegetation samples for all types except desert chaparral were unburned during 1954-98. Desert chaparral stands were former pinyon-juniper woodlands in 1954. Burned stands in other types had no temperate desert woodland cover.

Table 20. Population data of monotypic Joshua tree stands (n=21)

Year/variable	Density (stems ha ⁻¹)	Cover (%)
1954	13.6 ± 6.6	1.23 ± 0.68
recruitment	5.7 ± 3.5	-
mortality	2.0 ± 1.3	-
1998	16.2 ± 6.9	1.29 ± 0.76

Fire extent and precipitation variability



Above: July-June annual precipitation totals (cm) for 1850/51-2001/02 period of record.
Below: Percent departures from period of record mean annual precipitation.

Precipitation at San Diego, 1850-2002

Table 22. Total annual precipitation and departures from the mean at Palm Springs¹.

Year/burns (*)	Precipitation (inches)	PON ²	5-year running ave. PON ²	Year/burns (*)	Precipitation (inches)	PON ²	5-year running ave. PON ²
1940-41 ³	11.81	221	158	1972-73 ³	4.26	80	73
1941-42	9.64	181	150 F	1973-74	3.99	75	60
1942-43	11.85	223	176	1974-75	2.35	44	53
1943-44	11.17	210	183	1975-76	4.56	86	62
1944-45	3.99	75	182	1976-77 ³	6.86	129	83
1945-46	6.93	130	164	1977-78 ³	11.37	213	110 F
1946-47 ³	2.95	55	139	1978-79	7.40	139	122 F
1947-48	3.89	73	109	1979-80	16.21	304	175
1948-49	5.91	111	89	1980-81	2.52	47	167
1949-50	1.40	26	79	1981-82	3.85	72	156 F
1950-51	1.58	30	59	1982-83 ³	8.76	164	146
1951-52 ³	8.50	160	80	1983-84	8.31	156	149 F
1952-53	7.29	137	93	1984-85	2.97	56	99 F
1953-54	6.48	122	95	1985-86	5.98	112	112
1954-55	4.44	83	106	1986-87 ³	4.53	85	114 F
1955-56	2.69	51	110	1987-88	5.78	108	104
1956-57	4.01	75	94	1988-89	1.72	32	79
1957-58 ³	7.19	135	93	1989-90	1.43	27	73
1958-59	2.42	45	78	1990-91	4.93	92	69
1959-60	3.95	74	76	1991-92 ³	7.65	143	81 F
1960-61	1.56	29	72	1992-93 ³	12.96	243	108 F
1961-62	2.54	48	66	1993-94	2.57	48	111
1962-63	2.68	50	49	1994-95 ³	8.89	167	128 F
1963-64	6.24	117	64	1995-96	1.31	25	114
1964-65	3.40	64	62	1996-97	1.37	26	91
1965-66 ³	9.92	187	93	1997-98 ³	9.41	176	116
1966-67	5.69	107	105 F	1998-99	0.79	15	109 F
1967-68	4.78	89	113 F	1999-2000	1.74	32	82
1968-69 ³	7.61	143	118	2000-01	4.52	84	95
1969-70	4.05	76	120	2001-02	0.37	6	63
1970-71	2.21	42	91	2002-03 ³	4.20	70	44
1971-72	1.34	25	75				

1. Source. US Department of Commerce (1936-2003). Climatological Data, California.

2. PON, percent of normal. Cumulative five-year running average. 3

3. Warm phase El Nino events

F Major burns (> 100 ha) in Joshua Tree National Park.

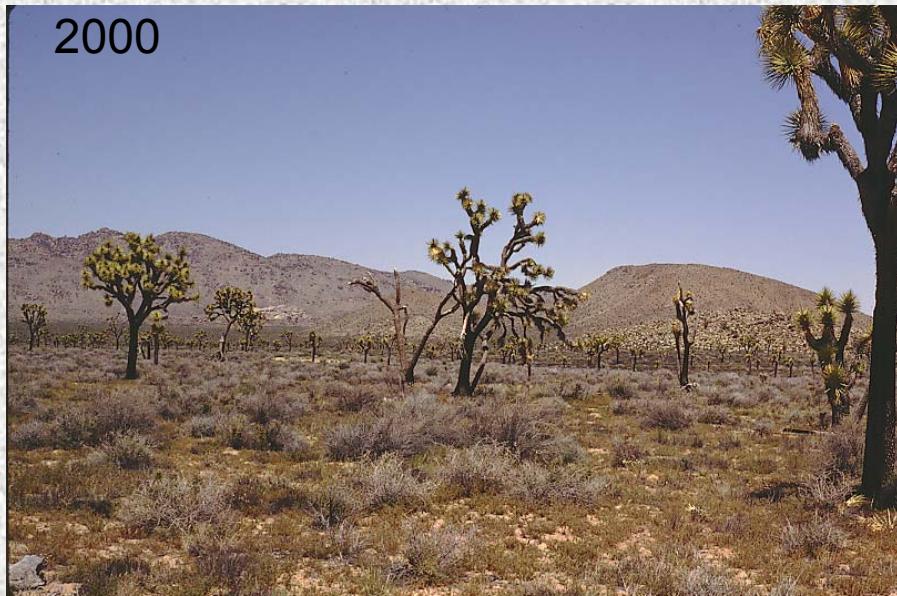
1977



1988

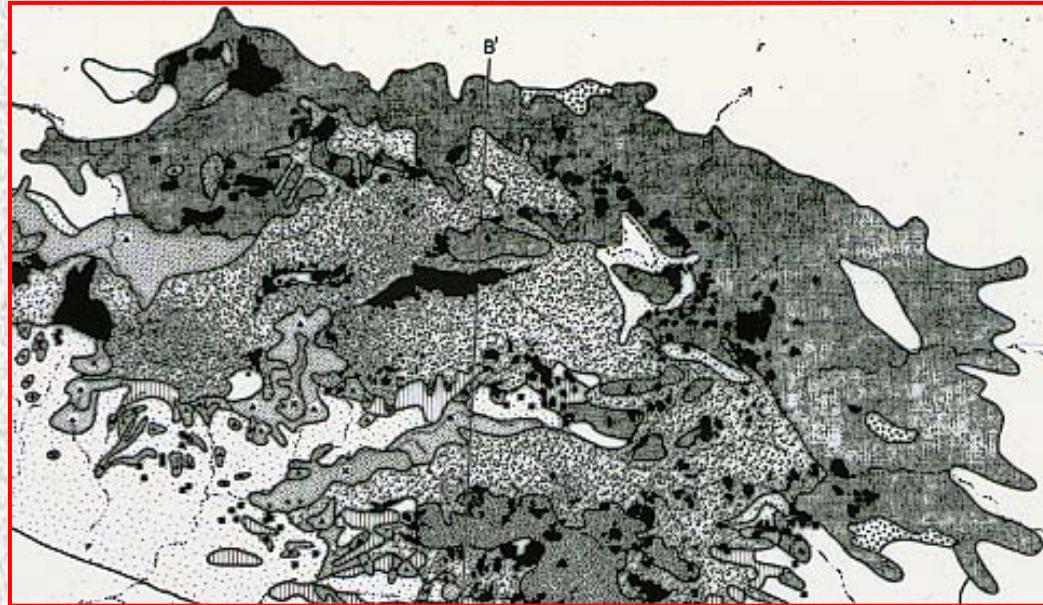


2000

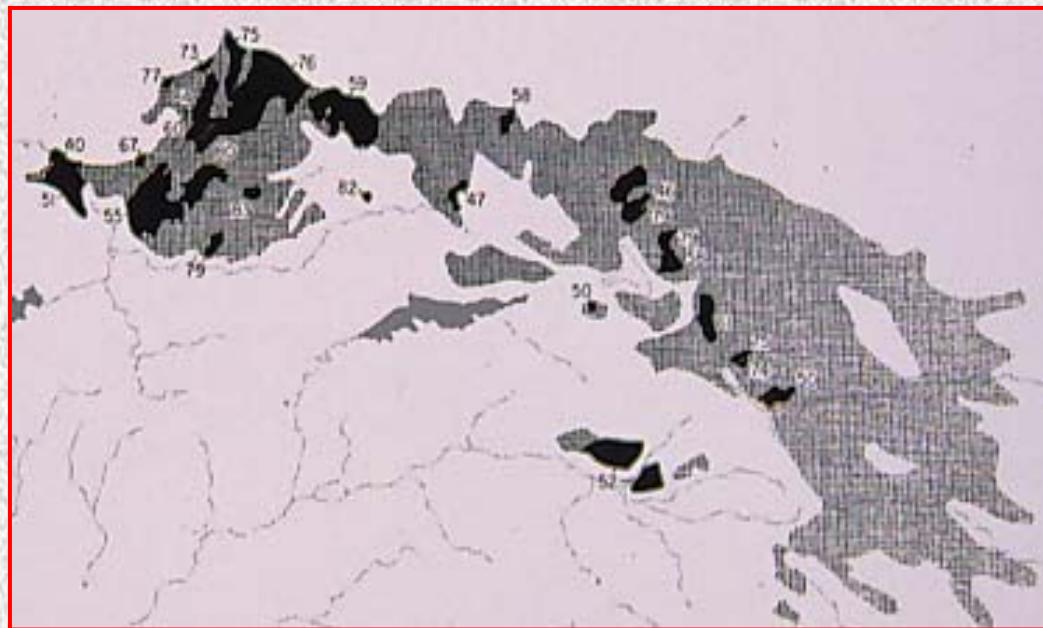


2002



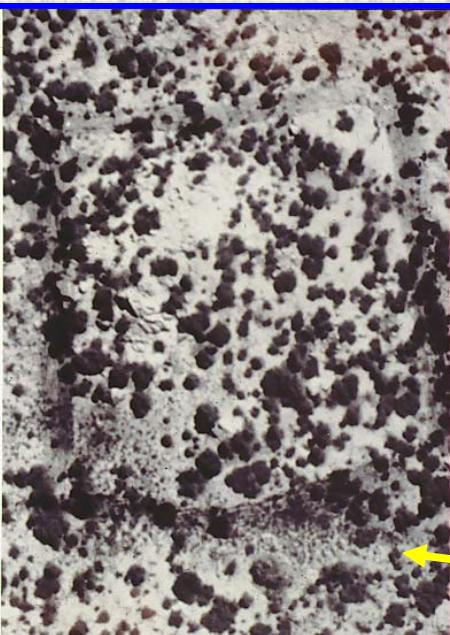
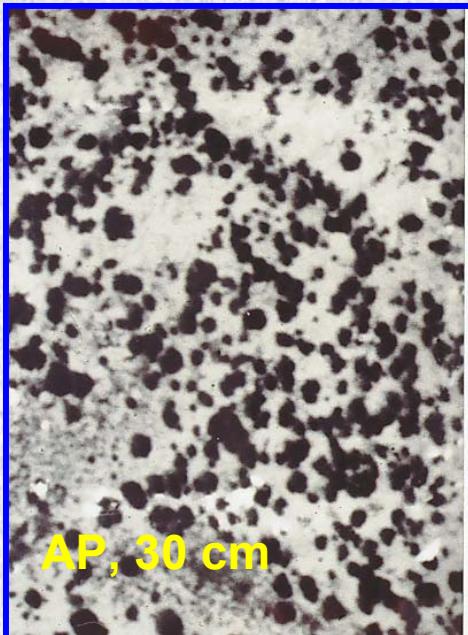


Pinyon-juniper stand-replacement fires in the San Bernardino Mountains



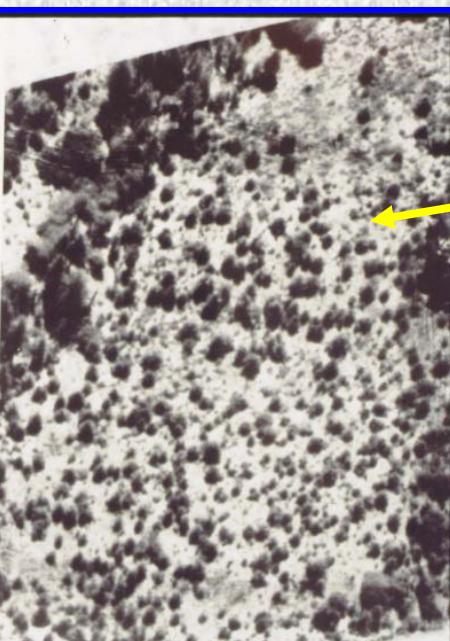
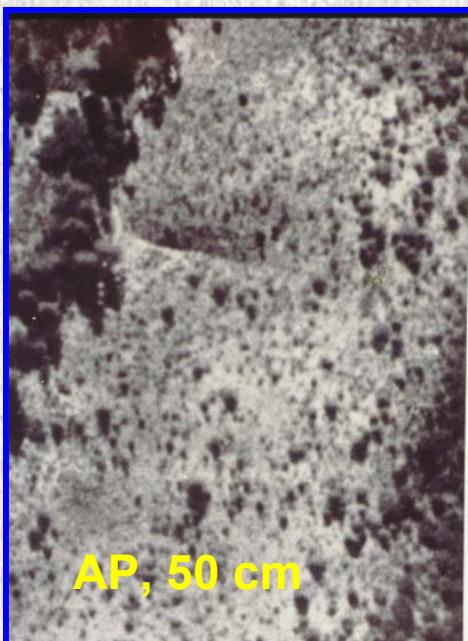
1938

1987

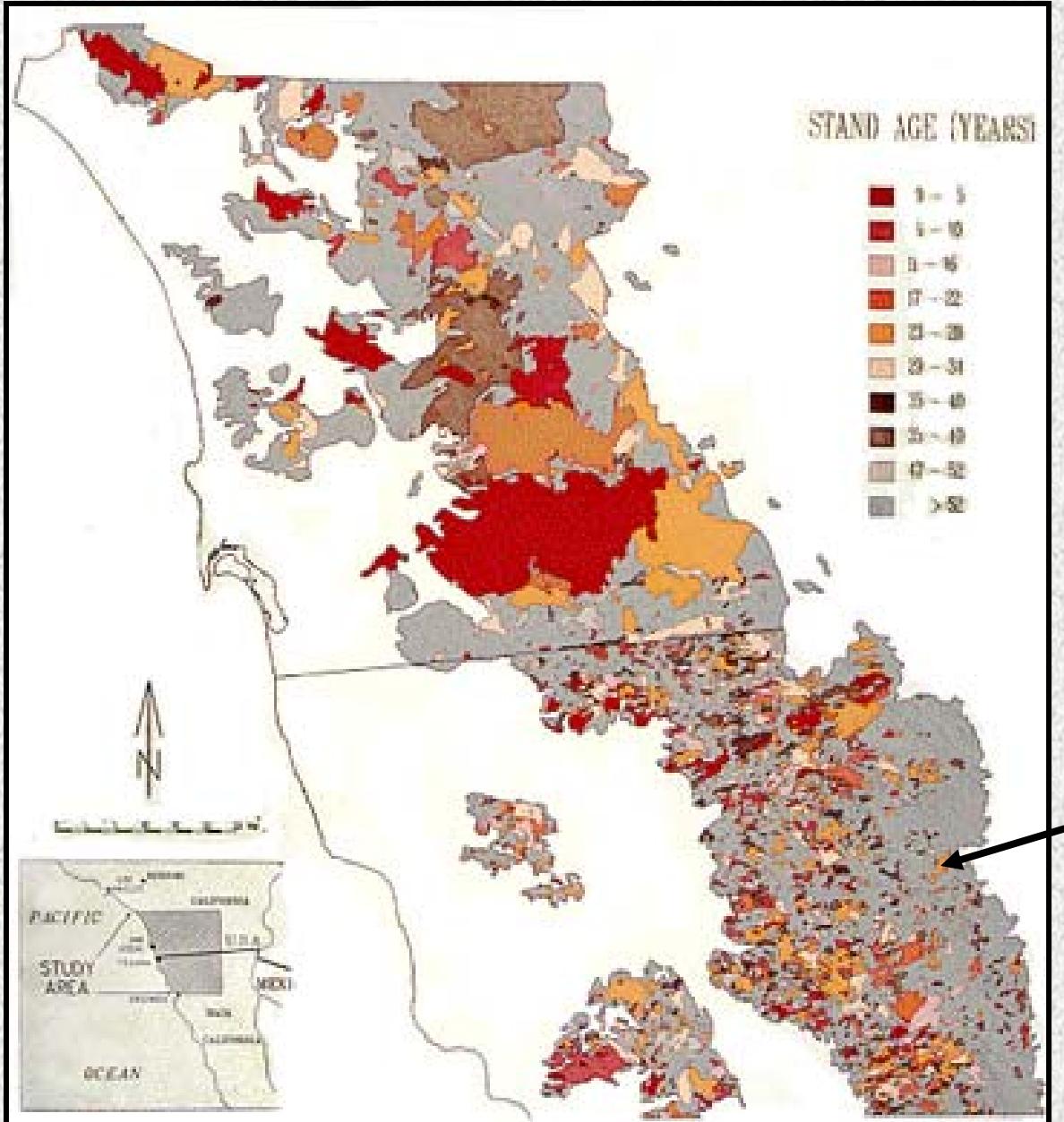


Productivity and fuel accumulation gradients, San Bernardino Mountains

Mostly single-tree fires



Stand-replacement burns at intervals of centuries

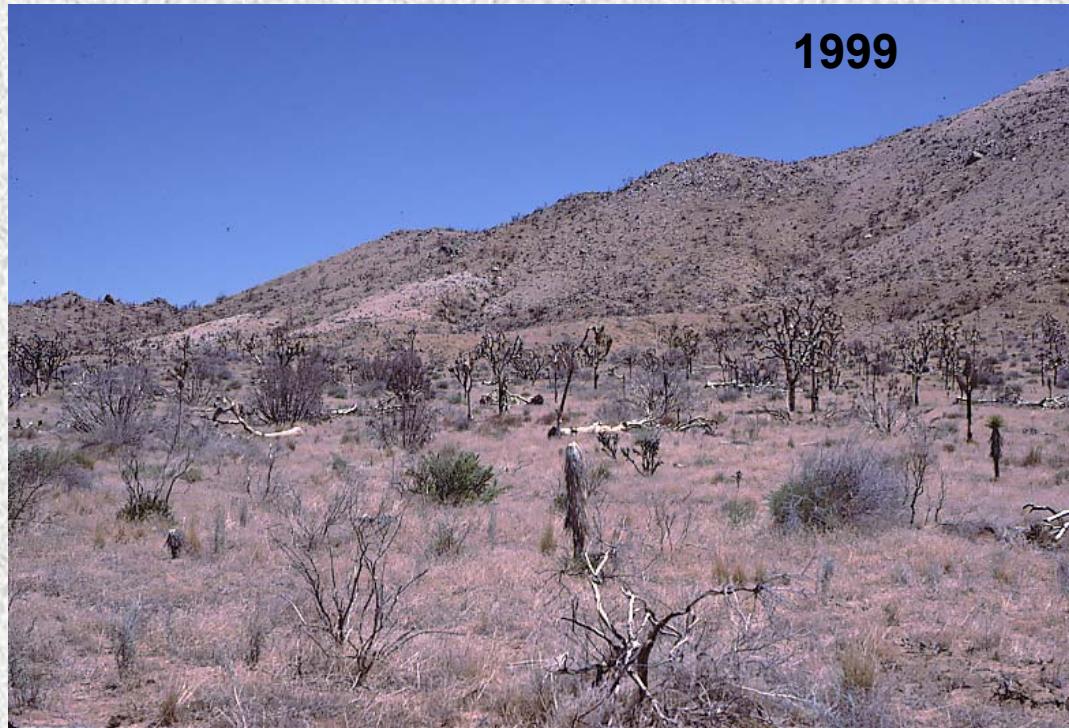


Fire perimeters 1920-71

Baja California, no suppression:

Fire rotation periods
in pinyon-juniper
woodland, >200 years

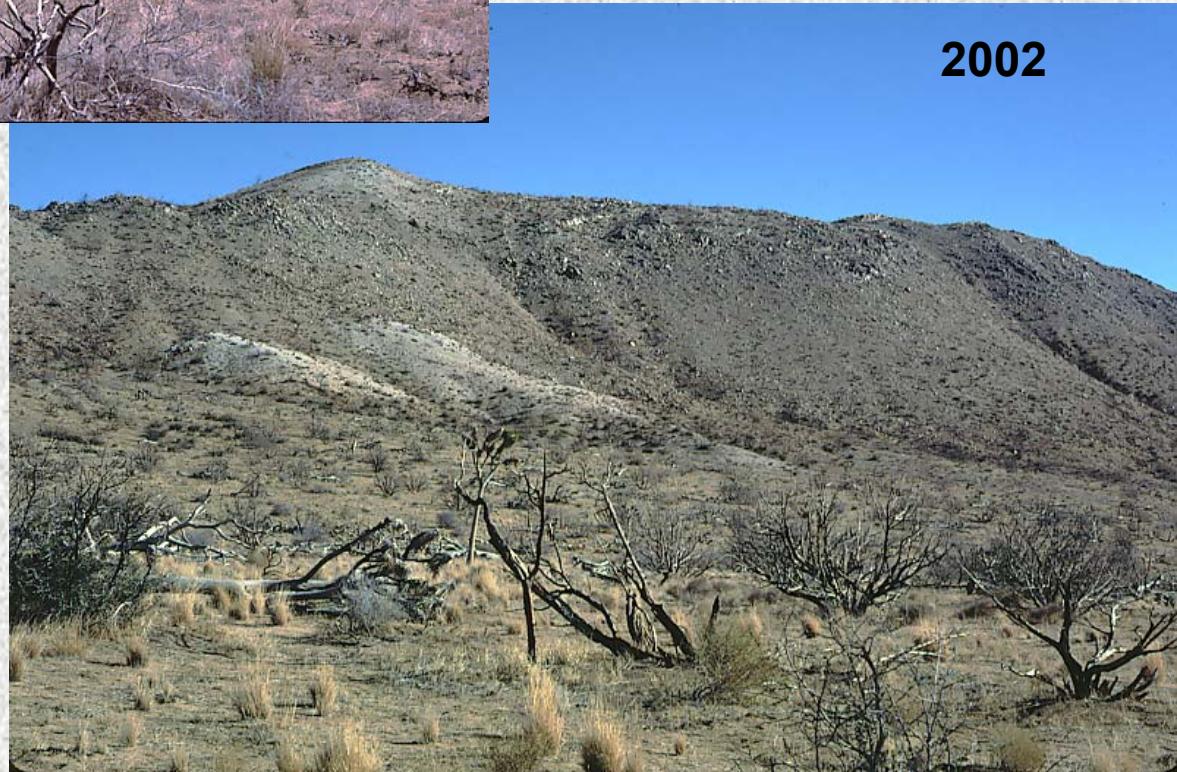
1999



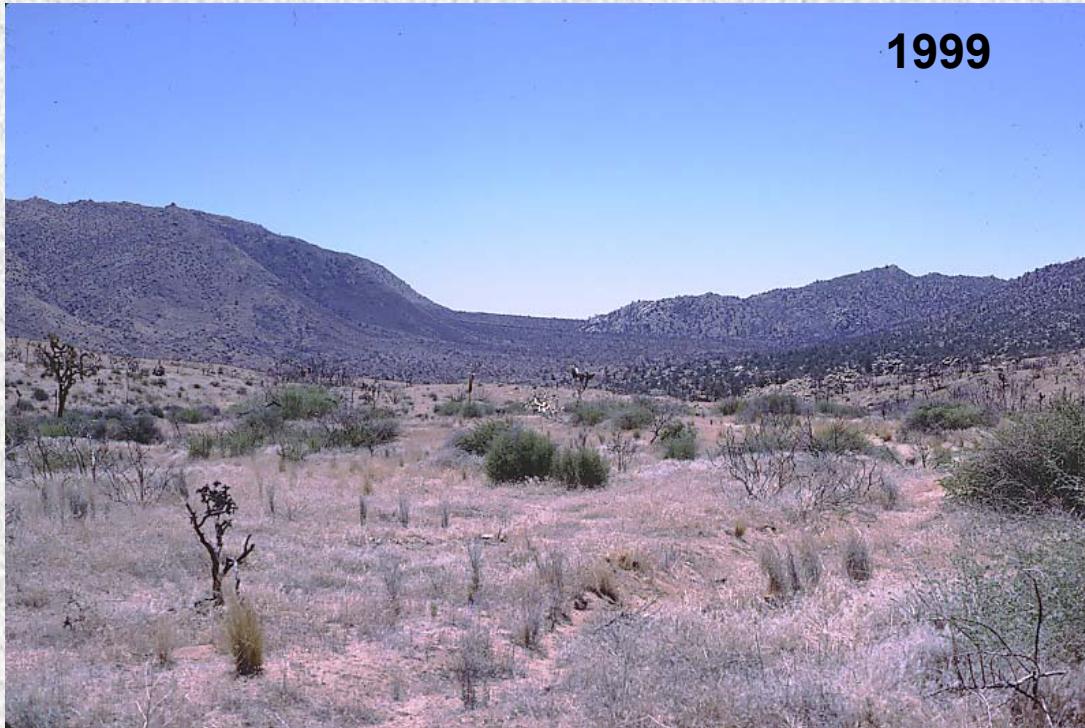
**Covington
Flat**

2002

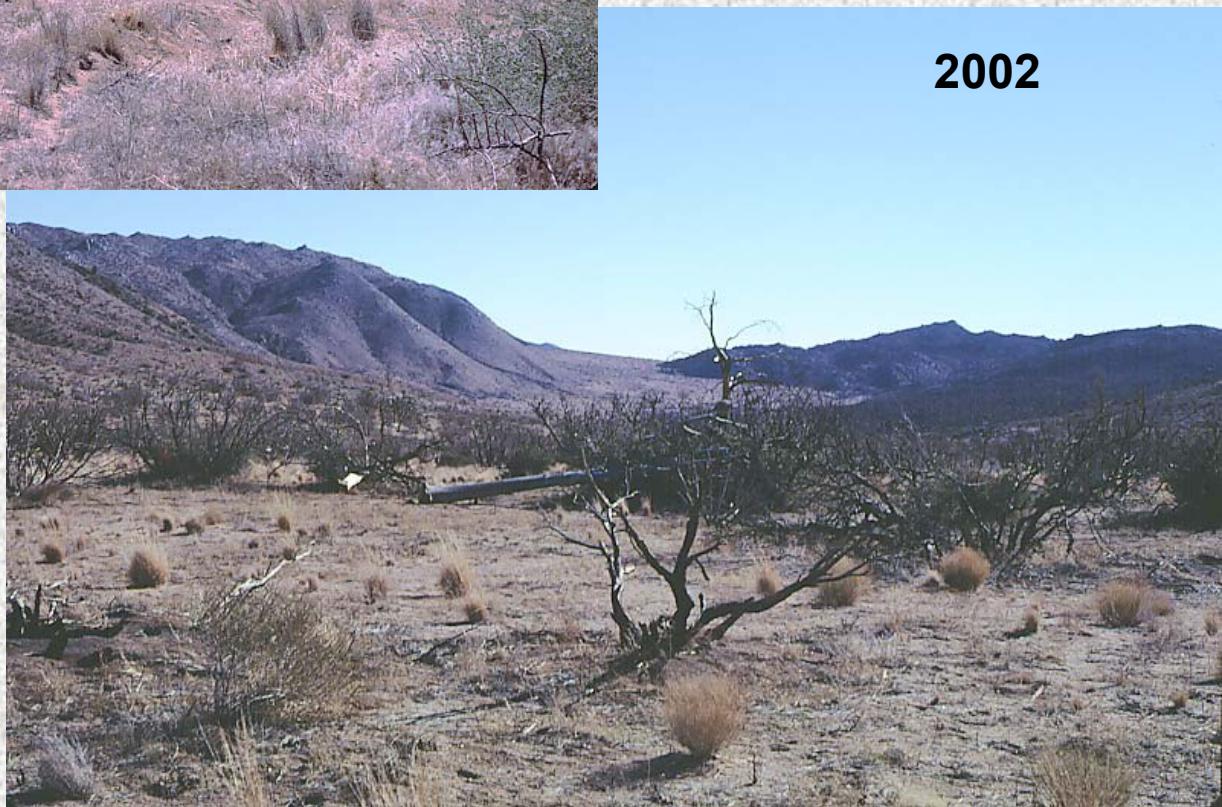
**BROME
CRASHES**

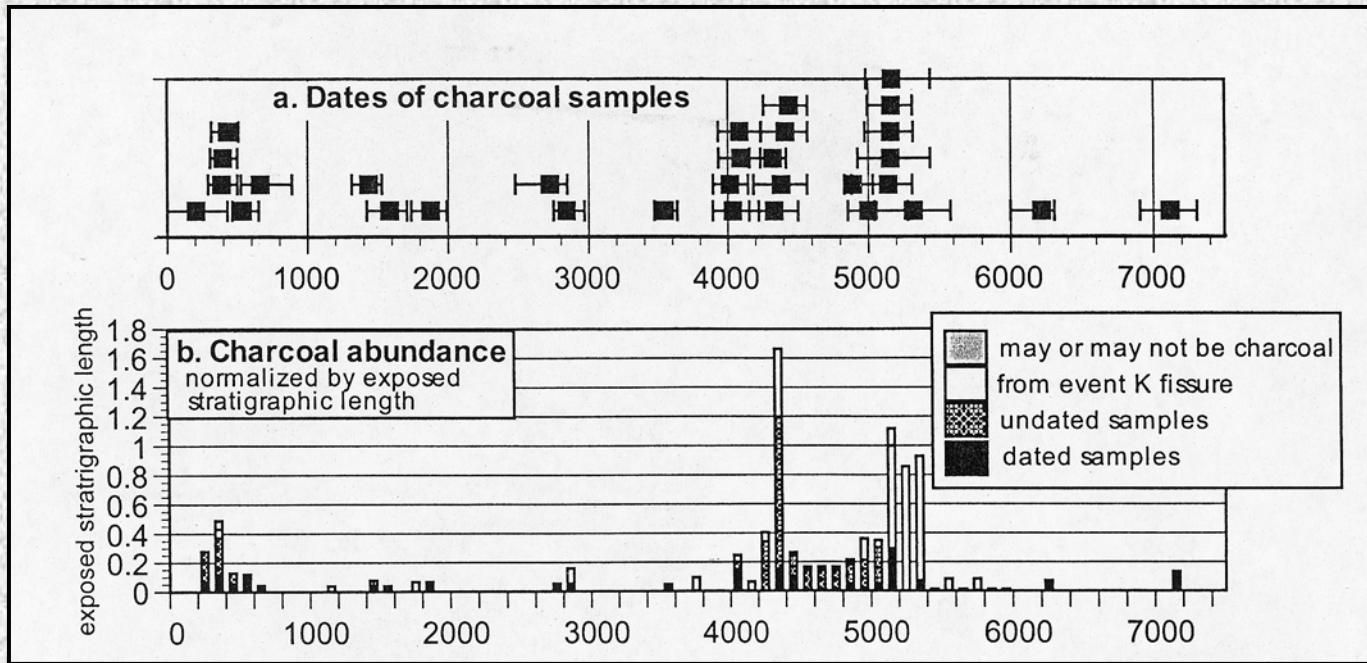


1999



2002





7000 year fire history

**El Paso Peaks
Seismic Trench**